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van den Hooff, Bart; Hafkamp, Loes

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Dealing with Dissonance: Misfits between an EHR System and Medical Work Practices

Bart Van den Hooff

VU University Amsterdam, b.j.vanden.hooff@vu.nl

Loes Hafkamp

VU University Amsterdam, loeshafkamp@gmail.com

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Dealing with Dissonance: Misfits between an EHR System and Medical Work Practices

Completed Research Paper

Bart van den Hooff
Vrije Universiteit Amsterdam
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands
b.j.vanden.hooff@vu.nl

Loes Hafkamp
Vrije Universiteit Amsterdam
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands
loeshafkamp@gmail.com

Abstract

This paper focuses on the question how misfits between an EHR system's capabilities and medical professionals' work practices influence these professionals' work practices. We explore the literature on misfits between ES and organizations, as well as the resulting dissonance between work practices before and after implementation of such systems. Our empirical study builds on qualitative data collected before, during, and after the implementation of an EHR system within one department in an academic hospital. Our findings show various misfits between system and work practices, leading to feelings of dissonance among medical professionals. In response to such dissonance, we find, users devise workarounds that entail either adjusting routines, or changing the use of technology in these routines. Based on these findings, our paper provides in-depth insight into the relationship between (1) misfits between systems and medical work practices, (2) dissonance and (3) workarounds in the implementation and use of EHR systems.

Keywords: Electronic Health Records, Workarounds, Organization-IS fit, IS implementation

Introduction

The healthcare industry is struggling with increasing pressures in terms of cost reductions and efficiency (Chandra, He, Liu, and Ruohonen 2013), and is increasingly looking for ways to apply IT to respond to such pressures. A well-known example of an information system used in healthcare is an electronic health records (EHR) system. An EHR system is aimed at improving communication and coordination among medical professionals (Ellingsen and Monteiro 2003, Hanseth et al. 2006), enhancing the safety, quality, and patient-focused nature of care, while aiming to contain costs and increase efficiency (Azad and King 2008; Harrison, Koppel, and Bar-Lev 2007). However, incongruence between an EHR system's capabilities on the one hand, and the existing work practices of medical professionals on the other, may keep an organization from realizing these potential benefits (Azad and King 2008; Prgommet, Georgiou, & Westbrook 2009; Safadi and Faraj 2010).

In this study we analyze how misfits between an EHR system's capabilities and medical professionals' work practices influence these professionals' work practices. We use Strong and Volkoff's (2010) six

different misfit domains as a framework to explore misfits between an EHR system and work practices. In order to subsequently analyze how these misfits occur in the work practices of medical professionals using an EHR system, we build on the work by Vaast and Walsham (2005) on dissonance between work practices before and after the implementation of an information system. Building on Leonardi's (2011) work, we assume that, in response to such dissonance, users change work practices by either adjusting routines, or changing the use of technology in these routines. The study presented in this paper seeks to explain how medical professionals interact with an EHR system, what misfits arise between professionals' practices and the system, and how this eventually affects their work practices, leading to workarounds that change either work routines or technology use. This leads to the following research question: How do misfits between an EHR system and medical practices affect medical professionals' work practices?

In answering this research question, our paper contributes to knowledge about how misfits between EHR systems and medical practices emerge, how these lead to feelings of dissonance with medical professionals, and how these professionals enact their agency to devise workarounds to deal with the constraining nature of the technology in order to restore feelings of consonance. With that, our paper provides in-depth insight into the inner dynamics that lead to workarounds, and the nature and consequences of these workarounds in the use of EHR systems.

Literature review

EHR systems and misfits

An EHR system is defined as a standardized collection of electronic health information about individual patients or populations, originating from several caregivers (Kierkegaard 2011). EHR systems are associated with enhanced patient care and other benefits in terms of clinical quality, patient safety, and efficiency (Buntin, Burke, Hoaglin, and Blumenthal 2011; King, Patel, Jamoom, and Furukawa 2014). The main contribution of an EHR system to such benefits is realized through the ability to share and access data from different organizations, departments and specialisms (Oborn, Barrett and Davidson 2011; Oborn and Dawson 2010). Therefore, it is assumed that implementing an EHR system will contribute to enhanced quality of healthcare.

The contribution of EHR systems to enhanced healthcare can take shape in at least two ways. First, the main contribution of an EHR system to improved quality of care and reduced costs is realized through the ability to share and access data from different organizations, departments and specialisms (Oborn, Barrett and Davidson 2011; Oborn and Dawson 2010; Tang et al., 2006). EHR systems enable the capturing of clinical information about patients, from their first point of contact with the health care system, and share this information across a continuum of care (Mayo, Poissant etc, 2004). All relevant information about patients is accessible in one central system. Thus, these systems enable caregivers to access digital records, eliminating poor penmanship (Menachemi & Collum 2011). Second, in addition to supplying several care providers with patient information, an EHR system also contributes to enhanced health care by providing data for clinical, population, and health services research (Mayo, Poissant etc, 2004). Therefore, it is assumed that implementing an EHR system will contribute to enhanced quality of healthcare.

Despite the benefits mentioned, characteristics inherent to an EHR system result in significant drawbacks. An EHR system is essentially an Enterprise System (ES), designed to integrate information and business processes based on notions of standardization, integration, and inscription of universal best practices across organizations. In that sense, an EHR system can be characterized as a "one size fits all" information system (Ellingsen and Monteiro 2003, Hanseth et al. 2006), designed to meet most needs of organizations, but not all needs of a particular organization (Strong and Volkoff 2010; Berente and Yoo 2012). Furthermore, in contrast to software that users can tailor to fit individual needs, ES are notoriously inflexible once they are implemented in an organization (Kallinikos 2004; Robey, Ross and Boudreau 2002). As Safadi and Faraj (2010) note, the inability of EHR software to tailor to the diverse medical practices and align with the complexity of the medical work is an important reason for EHR implementation issues. In other words, implementation of an EHR system can lead to misfits between the system's capabilities and the particular medical professionals' work practices.

Strong and Volkoff (2010) discuss that misfits arise as organizational and ES elements interact when people try to execute their jobs while using the technology, and hinder people in executing their work practices. Strong and Volkoff present a categorization of domains in which misfits between system and organization emerge:

- *Functionality* misfits occur when processes performed while using the system lead to reduced efficiency or effectiveness as compared to outcomes before implementation;
- *Data* misfits occur when data stored in or needed by the ES lead to data quality issues, for instance inaccuracy, inconsistency, or inaccessibility;
- *Usability* misfits occur when the interactions with the ES aimed at completing tasks are unnecessary or confusing;
- *Role* misfits occur when the roles defined in the ES are not aligned with people's skills;
- *Control* misfits occur when the controls ingrained in the ES provide too much control (constraining productivity) or too little control (leading to performance monitoring problems);
- *Organizational culture* misfits occur when the ES imposes ways of operating on people that conflict with organizational norms.

In each misfit domain two theoretically different types of misfit are identified: *deficiencies* and *impositions*. Deficiencies are problems that arise because the system lacks features, or actions users cannot take because the system is missing functionality, data fields, or control points. Impositions are problems that arise because the system has built-in characteristics such as integration and standardization and imposes work practices on people that are contrary to organizational norms and practices or that negatively affect organizational performance (Strong and Volkoff 2010).

Misfits and Dissonance

The six misfit domains form a starting point for an analysis of the misfits that may arise between medical professionals' work practices and the capabilities and requirements inherent in the EHR system. The fundamental issue here is the fact that the "one size fits all" character of an EHR system is not likely to fit with the specific and idiosyncratic needs that emerge in medical professionals' work practices. Medical practice is non-linear and situational; work practices are often iterative and reflect inferences that emerge through practice. "Therefore, medical activities are not easily modeled by predictable, linear sequences favored by software designers" (Bar-Lev and Harrison 2006, p.16). The nature of disciplinary specialization in medical practice makes it difficult to use a universal, computerized system as a "one size fits all" solution (Ellingsen and Monteiro 2003, Hanseth et al. 2006; Safadi and Faraj 2010).

In order to obtain a more detailed insight into the nature of misfits at the level of medical professionals' work practices, we use the concept of dissonance as discussed by Vaast and Walsham (2005). Dissonance refers to the discomfort experienced when agents perceive an inconsistency between their beliefs, attitudes, or actions. The implementation of a new system can lead to a feeling of dissonance when such a system requires a change in individuals' actions that conflicts with their beliefs, attitudes, and previous actions. In other words, when an EHR system requires medical professionals to work in a way that they perceive as conflicting with their ideas on how they should conduct their work, this may well lead to a feeling of dissonance in these professionals. In order to reestablish consonance, individuals adjust their practices and/or representations in order to integrate the new action and, hence, to reestablish a feeling of consonance. Eventually the state of consonance prior to the implementation of the new system will be reestablished, while at the same time work practices have been changed. However, it still remains unclear what exactly needs to be adjusted in work practices to reestablish consonance in work practices.

Dealing with Dissonance: Changing routines, or changing technology

In order to elaborate this point, we turn to Leonardi's (2011) ideas about the imbrication of human and material agency. Human agency refers to people's ability to form and realize their goals, implying that medical professionals can act in ways that will enable them to provide care to patients without being constrained by the EHR system. Material agency refers to technology's ability to act on its own without human intervention (Leonardi 2011), enabling people to conduct old tasks in new ways and to execute new tasks, which they could not do before (Leonardi and Barley 2008). However, as "material agents,"

technologies can also constrain social action once they are installed and left to operate (Boudreau and Robey 2005).

Leonardi (2011) explains how affordances and constraints are constructed in the space between human and material agency, and how this can lead to individuals either adapting their routines or adapting the technology in response to these affordances and constraints. Where affordances are possibilities for action and opportunities that emerge from actors engaging with a technology (Faraj and Azad 2012), constraints emerge when there is a lack of such opportunities and individuals are constrained in executing their practices (Leonardi 2011). In Leonardi's (2011) work, perceptions of constraint lead people to change their technologies while perceptions of affordance lead people to change their routines.

In the case of an EHR system, if medical professionals experience a misfit between the way they want to conduct their practices and what the system allows them to do, this will create to a feeling of dissonance. In response to this, medical professionals can either adjust the composition of their routines (i.e., their practices) or change the use of technology, in order to re-establish a feeling of consonance.

Conclusion

Based on this literature review, we elaborate our initial research question into two more concrete questions guiding our empirical research. We first want to investigate whether the implementation of an EHR system indeed leads to feelings of dissonance, and what concrete misfits between technology and practice emerge. Hence, the first question is: "What misfits do medical professionals experience between the EHR system and their work practices?". Second, we explore how the medical professionals deal with the experienced dissonance by adapting either their routines or their use of the technology. The second question then is: "How do medical professionals adapt their routines or technology use in response to these misfits?". In the next section, we outline the methodological approach followed in our case study.

Methods

Case study setting

A single case study was conducted to gain insights into how work practices change with the EHR system implementation. A case study offers the opportunity to collect rich data, that makes it possible to study how and why work practices change. Additionally, a case study offers the opportunity to gain a rich understanding of the context of the research and the processes being enacted (Morris and Wood 1991). The strength of this case study lies in the variety of evidence –interviews, observations, and access to the EHR system. This variety of sources enabled triangulation of findings between activities observed, those discussed in meetings, and spoken about in interviews. Also, data were collected both before and after the EHR system implementation, enabling us to compare work practices in both these phases.

The case study was conducted at the Ear, Nose and Throat (ENT) department in a major university hospital in the Netherlands. An EHR system was implemented in the hospital during in March of 2016. The EHR system that was implemented is a system provided by a privately held healthcare software company. This company is one of the market leaders in EHR systems, and its software is used in hospitals across the US, Netherlands, Canada, Finland, and other countries. The system's applications support functions related to patient care, from lab technologists to pharmacists. We collected qualitative data before, during, and after the implementation of the EHR system in this hospital.

Before implementation of the EHR system, medical professionals relied on different systems to execute different tasks. The different systems consisted of computer systems as well as paper files, and these were not connected to each other. Nurses used a Hospital Information System (HIS), in which they entered patient information such as checks and measurements, and which had very outdated functionality – for instance, moving from one page to the next required users to press "1". There was another online system that contained treatment files, care records, laboratory tests, outpatient visits, and OR reports. This system was mainly used by doctors, whereas nurses merely consulted this system. When a patient visit round started, nurses brought along green folders that contained relevant information on paper. All changes related to medication or checks for a patient were written on the medical sheets in these folders. All this information stored in different locations made it difficult to exchange information between different professionals and departments.

After the EHR system implementation, medical professionals worked in one shared EHR system. For nurses the system typically had to be used on a computer on wheels (COWs), movable computers which medical personnel bring with them to patient visits to conduct various activities like formatting an anamnesis, carrying out checks, and distributing medications. Doctors also used COWs for the EHR, but they also used their own desktop computers to update files.

Data collection

The research started in January 2016 with two days of pre-implementation observations. The observations were conducted by shadowing different medical professionals during their work day and asking them questions about the activities they executed. This offered the opportunity to follow one or two medical professionals closely, while watching other medical professionals from a distance. Shadowing was done for nearly all activities medical professionals executed during the day. Activities ranged from formatting an anamnesis with a patient, distributing medication, working in the information system, to returning a patient from the OR. These observations offered the opportunity to ask questions about work procedures and how individuals interact with the information system, and proved to be an important source of data when there appeared to be a mismatch between interviewees' responses and what was observed during the research site visit. During the observations, extensive notes were made on a mobile device which were later elaborated in a full-text report. After implementation of the EHR system (April 2016), two more days of observations took place, focusing on how nurses and (junior) doctors worked with the new EHR system. In total, across the two data collection rounds, 31 hours of observations were conducted. The observations led to an in-depth understanding of medical professionals' work practices, and with these insights it was possible to ask interviewees about key issues with the EHR system.

Both before (February 2016) and after the EHR system implementation (May 2016), seven interviews were conducted. Specific questions were formulated, in which interviewees were asked to talk about how they worked with patient information (before and after implementation) and about certain features of the EHR system. Examples of interview questions asked are: "Could you elaborate on how your work has changed since the implementation?"; "What has changed since the EHR was introduced? Please give an example".. Additionally, when medical professionals reported changes tasks or activities, they were asked in more detail to what extent routines or technology use changed.

Data analysis

The observations and interviews were all fully transcribed and coded. In the first phase of data collection, open coding was used because the research was still in its initial phase. Codes were assigned to how people described they would make use of information systems during their work. Examples of codes were: "double work", "information accessibility", "information sources" to indicate how medical professionals were facilitated by information systems during their work. For the second round of data collection, a coding scheme was made based on the six misfit domains by Strong and Volkoff (2010). These domains were extended based on the transcribed observations. This led to an extension of misfit domains with second order categories (see Table 1). Atlas.ti was used to support the coding and analysis of the data.

Findings

Misfits between Work Practices and the EHR System

The observations and interviews clearly indicate that the implementation of the EHR system significantly affected the work practices of both nurses and doctors. After the implementation, working with the EHR system quickly became inseparably linked to the way medical professionals conducted their daily work, and some clear misfits emerged. In the remainder of this section we will elaborate the misfits in each of the six domains discussed before as they were found in practice. Table 1 summarizes our coding scheme concerning these misfits and provides the structure of this section.

1st order code	2nd order code	Example
Functionality misfits	Formalization	<i>"We are not allowed to stop an order for an IV, which forms a drawback. So, you write a clinical memo in which you ask the doctor to stop the order for the IV."</i>
	Cumbersomeness	<i>"[...] I can only return a patient when that patient is on the ward. But if the patient is still in the recovery room and I start surgery, and the patient is returned during surgery, then I cannot fill in anything into the EHR system because I'm operating. While at the same time the nurse cannot do anything to the patient, because s/he is not officially returned to the ward in the EHR system."</i>
Data misfits	Inaccuracy	<i>"Recently, I witnessed that in a patient's medical history nothing was written about an illness. Later on I found out that the patient is a diabetic."</i>
	Unclearity	<i>"No, ideally you want it listed in a header, what the main problem is of that person, but that is not always filled in."</i>
	Lack of feedback	<i>"You don't know whether you have done everything, and whether you did it the right way."</i>
	Unfindability	<i>"I have to find out where it (the information) is."</i>
Usability misfits	Number of steps	<i>"All these clicks in the EHR system, that drives you totally crazy."</i>
	Difficult to change	<i>"I have tried to call to the helpdesk ask whether I can undo things, but that was not possible. I find this really unpleasant."</i>
Role misfits	Increased workload	<i>"Since we use the EHR system people start at 05:00 with their medicine round, otherwise you will still be busy at 08:00. Because you have to do a lot of things. Write a report, sometimes provide care for the patient, that takes a lot of time and you have to enter that information into the system as well..."</i>
	Reduced autonomy	<i>"There were many tasks that lay in a grey area. These tasks were not fixed, but we (nurses) conducted them anyhow. They (doctors) would just say: 'you can remove that IV'. But now a doctor needs to officially order these things."</i>
Control misfits	Ignoring notifications	<i>"I find that an annoying notification. When you just want to distribute medication at another time then you have to fill it in all over again. You need to enter into the EHR system that you rescheduled the dosage, and then you even have to give up a reason why you did it!"</i>
	Bypassing procedures	<i>"While I'm reading reports I already print out some labels, which means that the time does not always match with when the medicines are given. But otherwise it is undoable."</i>
Culture misfits	Patient-centered care	<i>"In the beginning I found it very hard because you are behind a screen and you cannot make eye contact with a patient. You are just sitting behind the screen and they (patients) don't like that"</i>

Table 1: Misfits between an EHR system and medical professionals' work practices

Functionality Misfits

Functionality misfits occur when using the EHR system reduces the efficiency or effectiveness of medical professionals' work practices compared to their previous work practices. The findings indicate that the EHR system imposes more formalized and cumbersome work practices on the users that indeed negatively influence the way they do their work.

Formalization: First, many tasks now require more the formal procedures, and orders to be entered into the system. After the EHR system implementation, tasks like filling in an anamnesis or discharging a patient are based on filling in forms with predefined questions in the system. Furthermore, administering medication or nutrition is now done after an order is placed in the EHR system by a doctor. This means that, if a mistake is made (e.g., the wrong nutrition is entered into the system), the nurse cannot just correct this by administering the right kind of tube feeding, but has to wait for a doctor to give the correct order. An example is given by a nurse:

"The other day I had to give medication, a pill. But in the EHR system is written that I need to give a suspension (liquid), this means that the pills cannot be scanned. You really need to give the suspension, but we ran out of the suspension. Then, the medication order really has to be adjusted by the doctor"

Nurses need to wait for an official adjustment in the medication order before they can proceed with distributing the medication. Even though nurses could solve the problem themselves by grinding the same medication in pill form, they are not allowed to do so by the system.

The fact that medical practice requires ad-hoc decision making when responding to contingencies, conflicts with the increased formalization of procedures as required by the EHR system. An imposition misfit emerges because the new procedure slows down the process and nurses lose the opportunity to change medication or tube feeding based on the situational factors such as mistakes in a doctor's order.

Cumbersomeness: Doctors also struggle with the EHR system and what it imposes on them, for example in the process of returning a patient to the ward. Doctors now need to perform a new action with the EHR system: officially returning a patient to the ward, by clicking through numerous steps in the EHR system, which makes this process very cumbersome and inefficient. A doctor describes how the translocation of a patient from the recovery room back to the ward leads to issues:

"Last week I went to the OR to perform surgery. Meanwhile a patient from the previous operation moved from the recovery room back to the ward. Then, you need to give a hundred thousand clicks for that, translocate a hundred thousand medicines. You need to officially return the patient to the ward in the EHR system, which is something we never had to do."

This is dissonant from the previous work practices, in which patients would simply go back to the ward where nurses could provide care. An imposition misfit occurs because the new action slows down the transfer process of patients and potentially even leads to dangerous situations. When a patient has not officially returned to the ward, nurses cannot view the patient in the EHR system. This implies that when a patient gets into a critical condition, a nurse is not able to check a patient's information his/her condition or allergies, for instance.

Data Misfits

Data misfits occur when data or data characteristics stored in or needed by the system, lead to data quality issues such as inaccuracy, inconsistent representations, or inaccessibility. The findings indicate that medical professionals encounter many data quality issues that indicate misfits with their work practices.

Inaccuracy: Medical professionals mention inaccuracy of data as a problem, for instance as they find that the procedures required by the system actually lead to data being incomplete or incorrect. Our findings indicate that this is often due to the formal and cumbersome procedures required by the system. For instance, the orders that now have to be entered into the system, also need to be officially terminated in the system, and many users forget this. The following inaccuracy has to do with failing to stop an order:

"Especially, some orders stay in the system longer than they should. For example, when someone has had an IV after surgery and we removed the IV, then that order needs to be stopped by a doctor. Subsequently, we [nurses] need to accept that order. But in reality the order is not always stopped."

In this case, the patient will leave the hospital without an IV, but the EHR system will indicate that the patient still has an IV inserted. The action in which medical professionals have to stop an order, is dissonant from their previous work practices, in which nurses simply removed the IV and would register that in the HIS. A deficiency misfit occurs because officially stopping an order is often forgotten and this makes the patient data inaccurate. For example, if a patient is brought to the intensive care in critical condition and in his/her file orders are still running for IV insertion, it seems as if the patient needs reinsertion of that IV, whereas this may be a very dangerous thing to actually do at that moment.

Unclearity: The formal and cumbersome procedures imposed by the EHR system also lead to a decline in clarity of data – i.e., confusion about how to interpret those data. For instance, after implementation of the EHR system, doctors have to fill in part of the anamnesis whereas nurses fill in the rest. This new action leads to data clarity misfits, because doctors at times neglect to fill in a patient's diagnosis which leads to confusion about the actual state of a patient. For instance, during the observations in April there was confusion between a nurse and a student about the reason why a patient was hospitalized. From the EHR system this reason was not clear, and only after reading through some of the initial reports that were written by a doctor, the nurse and student could find out that the patient had a social indication, which was the reason for hospitalization. A nurse's reaction to another similar incident is quoted below:

“But if you wanted to find out the reason for hospitalization then you had to go back into the notes to check the reason why. That takes a lot of time. When you have to do that for eight patients it will become a chaos.”

Here, a deficiency misfit occurs because the new action leads to a patient's diagnosis that is incomplete and therefore not clear. Consequently, nurses need to search for information about a patient's diagnosis in old reports, which takes up extra time. On the other hand, nurses may also choose not to look up this information, thereby assuming a patient's diagnosis to be correct – whereas it may be incorrect.

Lack of feedback: Feedback from the EHR system is important for medical professionals to check whether they have correctly filled in documents or reports. The EHR system does not provide this sort of feedback, which further leads to perceived data quality issues, as indicated by one doctor.

“Especially concerning the discharge of a patient it is extremely frustrating because you work neatly through the discharge navigator. You check off medicines, you make a new order, you plan a new appointment, a new medicine, or prescription. Then you click on sign, and you have no idea whether it went well.”

This example implies that medical professionals do not receive feedback after they have worked through an important phase in the system. This creates a feeling of discomfort, as they can not be confident that the information arrives at the right place. A deficiency misfit occurs which means that data quality issues continue to exist. Subsequently, data quality issues could lead to a delay in further treatment, transferring or dismissing a patient.

Unfindability: Another data misfit is created by the fact that the EHR system contains large volumes of data but, according to many interviewees, provides only little help in searching and finding the data needed in a certain work practice. In principle, almost all data about a patient is available in the system: diagnoses, test results, graphs, etc. However, the experienced lack of functionality in terms searching and finding relevant data creates a feeling of overload. As many tabs and data elements need to be clicked in the process, our data indicate that finding necessary data within the EHR system takes considerably more time than before. During an observation, a nurse mentioned: *“I would like to know when the last radio therapy was...”* After some fruitless searching in the EHR system, she said: *“I can always just ask the patient”*. This nurse was not able to find the information she was looking for in the system and decided to just ask the patient for the required information. Additionally, when medical professionals were unable to find the necessary information, they would ask for help from colleagues. All in all, a deficiency misfit was found to occur, because the system was perceived to provide insufficient functionality to find relevant data.

Usability misfits

Usability misfits occur when the interactions with the system are cumbersome or confusing. The fact that work practices themselves becoming inefficient and cumbersome (functionality misfits), is largely due to

the fact that the EHS system was seen as insufficiently user-friendly and complicated. For instance, when medical professionals interact with the EHR system they need to take many steps, experience difficulties in changing information and generally find this interaction ambiguous.

Number of steps: One of the main frustrations of medical professionals with the EHR system concerns the high amount of steps the system requires to complete a task. For instance, the process of filling in an anamnesis involves answering predefined questions in the EHR system, with the system determining the number of steps. This leads to a usability misfit because there are too many steps, as one doctor illustrates:

“There are way too many steps in the anamnesis. In any case the whole EHR system consists of too many tabs and moments to click. I feel this can be much simpler.”

In their previous work practices, doctors would have a conversation with a patient while using a questionnaire and would subsequently enter the information into the system. Now they follow a predefined list, which leads to uniformity and clarity, but also leads them to experience dissonance with the way they used to write an anamnesis. An imposition misfit occurs because the new way of working with a standardized list of questions is not the way that doctors fill in an anamnesis most efficiently or effectively, as not all questions are experienced as being relevant.

Difficult to change: Once data is entered into the system it is difficult to change, as a doctor illustrates:

“For example, yesterday I wrote a report but half-way I needed to leave for an emergency case. Then I thought: ‘I will finish writing this report tomorrow’. But that was not possible. So I had to write an entirely new report. Then somewhere I need to write an announcement that the last report was not sufficient and that the next person should read my ‘new report’. So, in the end I have had to write three new reports.”

From the interviews it became apparent that once entered into the system, data is very difficult to change and mistakes are hard to correct. Additionally, it requires executing many extra steps in the form of editing or calling someone to make sure the right document is read. This makes professionals experience dissonance with their existing practices, in which they could easily edit information. A deficiency misfit occurs because the new action of writing reports in the EHR system requires extra steps to solve a potential error.

Role misfits

Role misfits are manifested when the EHR system defines or prescribes roles for medical professionals that are not aligned with their skills and responsibilities. For instance, people are not authorized to conduct certain tasks by the EHR system, whereas they do have the skills to conduct these tasks and typically used to be able to conduct them before system implementation. Role misfits also occur when roles create imbalances in the workload, resulting in bottlenecks and idle time, or create mismatches between responsibility and authority.

Increased workload: The EHR system clearly affected the workload of both doctors and nurses. For instance, when an IV needed to be removed, in the old situation doctors and nurses just used to agree on this and the nurse could perform this task. The EHR system, however, prescribes that an official order needs to be given by the doctor before a nurse is allowed to remove an IV. Thus, these orders not only lead to functionality misfits, but also to a role misfit, as it increases doctors’ administrative workload. This is dissonant from previous work practices. An imposition misfit occurs because the new action leads to more work for doctors. This is illustrated in the following quote from a nurse:

“We carried out tasks for doctors. In the old situation we were allowed to take a urine sediment from a patient, all by ourselves. We also evaluated the test ourselves. Now, a doctor really has to intervene to order us to take a test.”

Additionally, our findings pointed towards an increase in workload for nurses. This especially emerged during night shifts, when nurses give out medication and conduct checks and tests on patients. The EHR system requires nurses to scan all patients and their medication before distributing the medication, and also do this within a predefined time frame (between 05:00 and 07:00 AM). This reduces the flexibility with which nurses can perform these tasks, which increases their workload, as is illustrated by this nurse:

“We grind a lot of medicines. Previously, you would grind medicines beforehand and place it next to a patient’s bed, in order to eliminate confusion. However, you did prepare it. But now you have to scan the patient, scan the medicines, grind them and administer the medicines in the EHR system. This retains you from preparing and starting already”

Having to scan medication and patients before being able to administer medication, and to do this in a limited time frame, is dissonant from nurses’ previous work practices. An imposition misfit occurs because these requirements force nurses to distribute all medication between these two hours, without any flexibility in preparing this task. The result is a peak increase in workload.

Reduced autonomy: The EHR system’s requirements in terms of orders and scanning medication not only affect workload, but also reduces nurses’ autonomy in performing their work, as this misfit concerns actions that nurses previously executed independently. The fact that nurses have to wait for an order before continuing their work not only affects their autonomy but is also potentially dangerous:

“You take away part of their freedom, while these are very knowledgeable people. They are put in a dependent situation because they just have to wait for our orders, otherwise they won’t do anything.”

The roles defined in the EHR system are inconsistent with nurses’ skills, as they are perfectly capable to inspect a patient and to discuss with a doctor whether to remove an IV. Whereas nurses lose part of their autonomy, doctors are charged with additional administrative tasks.

Control misfits

Control misfits occur when the controls in a system provide too much control, constraining productivity, or too little control, leading to the inability to evaluate or monitor performance properly. Our findings indicate that the EHR system’s tendency to impose control by formalizing procedures, in practice may have led to less control as professionals started to bypass procedures and ignore notifications about these procedures.

Bypassing procedures: We found many examples where medical professionals started bypassing procedures as they found them too cumbersome, and dissonant with their preferred practices. For instance, in the medication distribution process, both the patient’s wristband and the medication need to be scanned. From observations, it became clear that this procedure was frequently ignored. Nurses could not distribute medication when a patient was temporarily absent from the department. What was seen during these observations was that a nurse scanned the medication and subsequently put the medication next to a patient’s bed. The EHR system put up a notification to scan the patient, but the patient was gone and thus their wristband could not be scanned. The nurse then clicked the option “scanner is broken” and proceeded with the other patients.

Ignoring notifications: The formalization of procedures in the EHR system led the system to give users many notifications of things that needed to be done or things that had not been done according to the prescribed procedure. For instance, as described above, the procedures for administering medication were highly formalized in terms of scanning and time frames. When nurses do not adhere to these time frames, they get notifications from the EHR system which require them to provide reasons why medication was not provided on time. Nurses need to answer these notifications by clicking in the system through predefined choices, like for instance “medication was already given” or “eliminate medication”. When nurses stick to their own preferred time frame instead of following the system’s prescribed procedure, they receive notifications for every patient, and every medicine. This implies many notifications to click through in the system, and at a certain point nurses started ignoring these notifications, as illustrated by these two quotes from nurses:

“For example, I need to distribute 10 different pills, which are scheduled for 08:00, but I have to give them at 06:00. You get a notification saying: “medication is not provided at the set time”. I click through the eight notifications (for eight pills), then with the ninth notification I assume it is the same notification. So I also click that one away.”

“I have an order to give medication and I won’t do anything with that notification on the screen. I don’t even read it... I get notifications all day. I just need to give four times 1000mg. So that is what I do.”

This is something we observed quite frequently in our data: medical professionals (nurses as well as doctors) were so overwhelmed by all these notifications, many of which were considered irrelevant because they knowingly followed a procedure that was different from the prescribed one, that they started ignoring them. An imposition misfit occurs, because the system exerts too much control by sending notifications – which ironically leads to a potential lack of control since these notifications are ignored. Ignoring notifications poses a danger in case the notification concerns a serious warning – for instance, when medication has already been distributed earlier, and a new dose is about to be given to the patient

Culture misfits

Organizational culture misfits are manifested when medical professionals have to execute tasks by the EHR system, which conflict with organizational norms. In our case study, this misfit concerned the norms that medical professionals espoused in terms of patient-centered care, which they felt were ill at ease with the use of the EHR system – particularly the use of the system during patient interaction. The new action in this case entails using the EHR system to enter and retrieve information during a consult with a patient – either during a patient visit, or during a consult in the doctor's office. This new action leads to a culture misfit, because medical professionals spend more time on the system than on patient care, whereas they all adhere to the norm that interaction with the patient is central to their work practices. They clearly experience dissonance, as illustrated by these quotes:

"You are just very impersonally engaged, especially when you write an anamnesis. Then you have to enter all these details into the system while there is such a big screen in front of your face. I don't find that patient friendly, I must say"

*"Sometimes it just feels impersonal. For example, when someone is crying because s/he is nervous and then I'm like this: *nurse pretends to be typing and looking at a screen* 'Oh, tell me how are you doing?'"*

An imposition misfit occurs because the new action in which more time is spent on the EHR system does not fit with the cultural norms. The EHR system imposes work practices that are more focused on data entry and retrieval, in which there is less time for face to face contact with a patient.

Workarounds and Workarounds: Changing Routines and Technology Use

Our findings clearly show examples of many misfits between the EHR system and medical professionals' work practices. These misfits lead professionals to experience a feeling of dissonance: they are uncomfortable with the fact that the system requires them to work in ways that are contrary to the way they used to, and prefer to, work. Interviewees frequently expressed feelings of discomfort with the tension they experienced between system requirements and their extant practices, indicating that dissonance indeed occurred. Our observations also supported this: we observed nurses getting confused and frustrated in their interactions with the EHR system, and also heard them verbally express these feelings during these interactions. Furthermore, our respondents also discussed various ways in which they responded to this tension, aiming to restore consonance through various actions. In essence, we found many *workarounds* – some of which meant that professionals changed their established routines, while others entailed adapting their use of the technology in line with their preferred work practices.

For instance, when nurses encountered a **functionality misfit**, they basically worked around the system and its imposed work practices – for instance, by not meeting the EHR system's requirement of waiting for an order. As illustrated by one nurse, referring to the process of removing an IV:

"Nothing happens for 1.5 hours, that is just inconvenient. Now I can say: 'I will just do it myself'. But not everyone does that. I will just do it by calling the doctor and enter the details into the system myself. Doctors need to confirm that later, but I am able to execute the action immediately. That is convenient."

This nurse enacted her human agency to create a workaround, changing the use of the technology. Instead of waiting for an order, the IV is removed by a nurse and a doctor will confirm the order afterwards. Thus, the system is not used to actually guide the process, but only to justify and register actions already taken.

In case of a **data misfit**, we also found examples of workarounds. For instance, one doctor says, referring to the lack of feedback from the EHR system:

“You don’t know whether you have done everything, and whether you did it the right way. You think: ‘whatever’. Then you hope that the person you have sent a message to understands what it says. Thus, I often send an e-mail afterwards with the message: ‘I sent patient x to you, can you look at it’. I don’t dare to trust on it (the EHR system) entirely.”

This is an example of a workaround we found frequently, in which professionals enacted their human agency to adjust their work practices by using other technologies than the required EHR system to provide and obtain feedback.

When it comes to **usability misfits**, medical professionals’ perceived that the EHR system constrained the flexibility in how they shaped their work practices. Medical professionals tended to work around executing every step as imposed by the EHR system, by skipping certain steps. As a nurse illustrates:

“After a while, when you get familiar with the anamnesis form you can decide for yourself to skip certain questions.”

Thus, medical professionals adjusted their routine by deciding for themselves what is relevant, changing the use of technology by not answering every question. Selectively asking questions represents an approach to cope with irrelevant questions on standardized forms through adapted use of the technology.

Concerning **role misfits**, we saw examples of adaptation of both routines and technology use. The limited time frame for medication distribution, for instance, led to medical professionals changing how they organized their shifts. Supervisors and nurses agreed to start one day shift a day at 7:00 instead of 7:30 to unburden the nurses from the night shift. As discussed during a team meeting:

“After the introduction of the EHR system the nightshift experiences an increased workload. Therefore, one dayshift will from now on start at 07:00. However, it may not be necessary to have someone start at 07:00 every day – this is only needed when 2 or more operations are scheduled. Therefore, when a nurse is scheduled for a dayshift starting at 07:00, s/he is allowed to call the day before to check whether there are two or more operations scheduled.”

In this case, professionals enact their human agency to adjust their routines. The EHR system’s features did not permit a reduction in the workload - therefore, nurses needed to adjust their routine in terms of scheduling day shifts.

The increased work load due to the official orders that were required by the system led to changes in technology use: some nurses communicated with a doctor to discuss the option of taking a test already and then register it in the system afterwards. As one nurse illustrates:

“Now I can say: ‘I will do it myself’. I will just call the doctor and register it in the EHR system. Then, the doctor needs to confirm it later, but this allows me to execute the action immediately. That is convenient.”

With regard to **control misfits**, we already discussed two varieties of workarounds in the previous section: professionals bypass formal procedures and ignore notifications. Nurses work around the technology by overriding notifications and handing out medication according to their own schedule. Nurses can click notifications away by giving up a false reason when the system asks why a patient or medicine was not scanned.

Another example of these workarounds concerning control misfits was found in how nurses use patient wristbands in practice. In order to work around the constraints imposed by the technology, nurses printed out extra wristbands - duplicates of the wristbands patients wear. Scanning the duplicates enabled nurses to prepare medication and to work faster. Instead of having to walk to the patient, scan the wristband, walk back, scan the medication, and subsequently give the medication, nurses could scan the duplicate wristband and scan the medication immediately thereafter:

“What I sometimes see, and I also said: ‘we shouldn’t do that’, is that people print out an extra wristband or an extra sticker, which they put in the medicine drawer. They will scan these duplicate wristbands or stickers instead of the patient. I’m not supportive of that.”

In this case, medical professionals’ routines remain the same as before EHR system implementation, but they change the use of the technology, ignoring and bypassing formalized procedures and notifications to be able to execute their work practices in their preferred way.

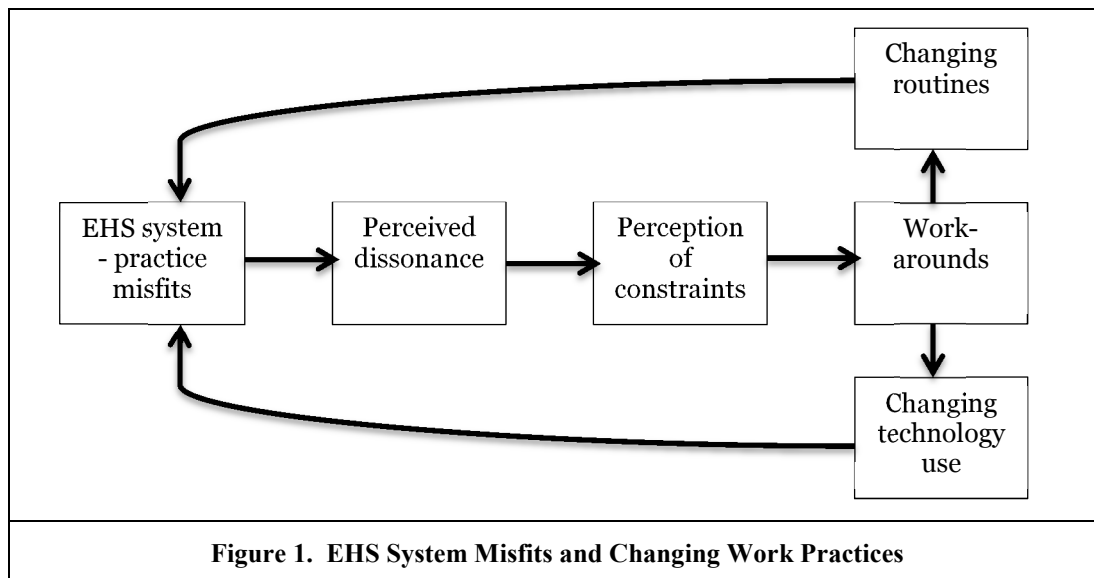
Finally, **culture misfits** led to a strong feeling of dissonance, but this turned out to be very difficult to resolve. The mandatory continual interaction with the EHR system constrained nurses' ability to interact face to face with a patient. In response to this dissonance between EHR use and professional norms, nurses enacted their human agency to ensure that the interactions with patients were convenient for patients, but still using the system. As one nurse illustrates, it was difficult to reconcile these two:

"Sometimes I think, if I do not understand the system I'll just make sure the patient is comfortable"

Discussion

In conclusion, the findings reported above clearly indicate that misfits emerged between medical professionals' work practices and the EHR system's capabilities and requirements, in each of the six domains distinguished by Strong and Volkoff (2010). In general, the EHS system was perceived as imposing new practices on the professionals, which significantly differed from their previous work practices in many respects. This caused medical professionals to experience dissonance between their actions, practices, and representations. The findings indicate that medical professionals have the feeling that these imposed work practices offer them less opportunities and freedom than they experienced in their previous work practices. Although this is not by definition a negative phenomenon in terms of patient care (the increase in standardization and homogeneity in practices inherent to an EHR system is part of its contribution to enhancing such care), this dissonance is found to lead to workarounds – and these, in turn, may well have such negative effects. Workarounds indicate that medical professionals use the EHR system in a different way than the system's designers intended, which may negatively affect the extent to which intended benefits are realized.

In theoretical terms, medical professionals constructed the perception that the system constrained their human agency – they experienced a reduced “ability to form and realize their goals” because of the way the system imposed a way of working that they perceived as dissonant with their beliefs, attitudes, and previous actions. Based on these perceived constraints, medical professionals typically enacted their human agency to create workarounds. Workarounds either entailed adjusting routines, or using the technology in a way that diverged from the intended use. Through this adaptation of either routines or technology use, the use of the EHR system changed, likely leading to different perceptions of misfits and dissonance over time. This logic is summarized in Figure 1 below.



Theoretical implications

By unpacking the general misfit between an EHR misfit and medical work practices, our study provides an in-depth insight into how particular misfits in different domains lead to perceptions of dissonance, to which medical professionals respond by devising various workarounds.

With that, the main contribution of our study is an increased understanding of workarounds in health IT. A workaround is defined as “a goal-driven adaptation, improvisation, or other change to one or more aspects of an existing work system in order to overcome, bypass, or minimize the impact of obstacles, exceptions, anomalies, mishaps, established practices, management expectations, or structural constraints that are perceived as preventing that work system or its participants from achieving a desired level of efficiency, effectiveness, or other organizational or personal goals” (Alter, 2014, p. 1044). As Alter (2014, p. 1042) explains, workarounds are a well-known but understudied phenomenon – “Even in healthcare, where workarounds are widely recognized”. Azad and King (2008, p. 264) also observe that “theoretical understanding in the IS literature of the inner workings and dynamics of computer workarounds remains rudimentary”. Although their own study and other work (e.g., Safadi and Faraj 2010; Zhou, Ackerman and Zheng 2011) have certainly enhanced such insight, our findings further contribute to unpacking the dynamics and nature of IT-related workarounds in healthcare.

The findings in our paper provide further understanding of how these workarounds emerge from specific misfits between the EHR system’s capabilities and requirements on the one hand, and the medical professionals’ work practices on the other. As Alter (2014) explains, such workarounds are often responses to *technology misfits*. Further specifying these misfits in terms of Strong and Volkoff’s (2010) work provides the insight that in response to different categories of misfits, people enact their agency in different ways to *overcome inadequate IT functionality* (deficiencies) and *bypass obstacles* (impositions) that result from these misfits.

Building on this, our findings provide some first input for further theorizing about this relationship between specific misfits and specific kinds of workarounds. In general, our findings indicate that *imposition* misfits primarily lead to what Ferneley and Sobrepiezez (2006) define as *hindrance* workarounds in terms of *changing technology use*: medical professionals devised alternative ways of using the technology in response to their perception of the system as imposing ways of working that were too time consuming, onerous or difficult, aiming to find some way to match the EHR system to their existing work (Safadi and Faraj 2010). We found examples of imposition misfits in terms of functionality, usability, role, and control misfits. Our data indicate that in response to these imposition misfits, the medical professionals tried to circumvent the imposed way of working with the goal of being able to maintain their existing routines, by using the technology in alternative ways: e.g., skipping prescribed steps, printing extra wristbands, entering data that should officially entered by others, or using the EHR system only for registering activities afterwards, instead of letting the system actually guide these activities. Thus, they do use the system, but only partially or in different ways than intended, thus bypassing obstacles and constraints that they perceive to be inherent to the way of working that the system imposes on them.

On the other hand, *deficiency* misfits seem to be primarily associated with workarounds that Alter (2014) describes as “overcoming inadequate functionality”, through *changing routines*. We primarily found deficiency misfits in terms of data, where medical professionals devised routines that were aimed at compensating for the lack of functionality provided by the EHR system. These routines primarily entailed using alternative sources of information and alternative channels for communication to compensate for the deficiencies in the EHR system. Where a system does not provide the functionality that is essential in completing a task, there is not much use in changing the use of the system – the needed functionality must be found elsewhere, which means that alternative routines are designed that make use of sources and channels that are not part of the system. Based on this, we propose that the perception of imposition misfits will likely lead to workarounds that entail changes in technology use, whereas the perception of deficiency misfits will be related to workarounds in the form of adaptation of routines.

Two important remarks need to be made here. First, the fact that we characterize the workarounds we found in terms overcoming “hindrances”, does not mean that these workarounds themselves are by definition positive. Studies on IT-related workarounds in healthcare indicate two important effects of these workarounds in terms of Alter’s (2014) Theory of Workarounds: they enable professionals to

continue their work in spite of inadequate IT functionality and a perceived need to bypass obstacles – while at the same time *creating hazards*. As Zhou et al. (2011, p. 3353) say, “healthcare professionals are masters at workarounds and oftentimes clinicians view workarounds as the only way to accomplish their work”, but on the other hand, workarounds are undesirable because they imply deviation from standard process which reduces the efficiency of the medical operations, and threaten the potential for gains in efficiency of EHR systems by reducing process variability (Azad and King, 2008; Halbesleben et al. 2010). In our findings, we showed examples of workarounds that did enable nurses and doctors to continue their existing work, but that also created hazards – and that essentially exert a negative influence on the potential contribution of an EHR system to improved patient care. For instance, ignoring notifications may help nurses continue their work more efficiently, but it also creates a hazard when valuable notifications are ignored – and the fact that an EHR system contains integrated patient information based on which it can provide such notifications is one of the many benefits it offers in improving patient care. This makes it only more important to obtain an in-depth understanding of how workarounds emerge from the misfit between EHR system and work practices.

Related to the previous remark, we should also clarify that incongruence between a system and extant practices is inherent to any system that aims to improve current ways of working. In our case, for instance, the situation before the EHR system implementation was characterized by the use of a variety of different information sources, both computerized and paper-based. Although the medical professionals may have perceived this way of working as less problematic than the practices inherent in the EHR system, this is precisely the kind of situation that an EHR system aims to improve. As discussed before, EHR systems contribute to improved patient care by providing a single and reliable source of patient data and enabling the exchange of this data across disciplinary borders. So although doctors and nurses may perceive the standardized way of working inherent in an EHR as an imposition, a misfit that leads to feelings of dissonance, it is important to realize that this was exactly the kind of situation that an EHR system aims to resolve in order to improve patient care. So it is important to distinguish misfits (a feeling that a system is interfering with the proper execution of organizational operations (Strong & Volkoff, 2010)) from potential opportunities for change and improvement, where the focus is on EHR functionalities that increase quality of care and/or make tasks easier to perform.

Practical implications

A first practical implication is that hospitals should be aware of the existence and dual effects of workarounds related to EHR systems: on the one hand, make use of the creativity of users to possibly improve routines as they are embedded in the system, on the other hand, develop processes and tools that help preventing hazardous side effects of these workarounds. Realizing that there are various misfits between EHR capabilities and requirements on the one hand, and medical practice on the other, enables hospital management to design measures aimed at specific misfits. In order to reap the potential benefits that an EHR system can provide in terms of improved healthcare, it is important to be aware of the various workarounds that can emerge in response to experienced misfits between system capabilities and requirements on the one hand, and existing work practices on the other, and devise strategies to counter the negative effects of these workarounds.

Also, our findings are once more a reminder that IS implementations are often too much focused on technology alone and tend to have insufficient regard for the fact that they are always part of larger organizational changes. As Markus (2004) observed, a balanced approach towards what she calls “technochange” (technology-driven organizational change) is crucial in aligning technological and organizational needs, requirements and capabilities. This is especially important in healthcare settings, where the misfit between “one size fits all” solutions and idiosyncratic practices is especially prominent.

Finally, as Safadi and Faraj (2010, p. 2) say, for EHR systems to succeed, they should be highly flexible and allow for customizations and modifications in order to match the particularities of the medical practices. Clearly, the “one size fits all” character of current EHR systems does not meet that criterion. A possible strategy to deal with that shortcoming is to build a “flexible layer” on top of the EHR system that enables more flexible and mobile use of the system, providing medical professionals with the appropriate data based on their location and particular activities, and a user-friendly interface to be able to access and use that data. Using mobile apps and mobile devices to create such a flexible layer seems a promising approach.

Limitations and suggestions for further research

Although our findings provide in-depth insight into the emergence of misfits, dissonance and workarounds during an EHR system implementation, they are based on one single case that was followed during a limited time frame. The study was conducted across a period of approximately 6 months, in which data was acquired between February and June. One downside of this short period is that our final round of data collection took place immediately after the system's implementation, which means that some of the phenomena we find could be due to people still getting used to the system. Additionally, the number of interview participants to the study is limited to fourteen (7 before and 7 after implementation). However, during observations and participation to team meetings other people were observed and spoken with.

The strength of our analysis is that it covers pre-implementation, implementation and post-implementation, but for future research it would be valuable to return to our case organization to study how use of the EHR system has evolved after the initial post-implementation period. More generally, a truly longitudinal case study would be a valuable avenue for further research, which would also enable researchers to study the interaction between users and the EHR system when more time has passed since the actual implementation, and to collect more extensive data. Furthermore, to yield findings that would be more generalizable across specific cases, studies like the one reported here can be conducted at various other sites. Based on such more generalizable insights, it should be possible to further validate our first insights about the role of specific misfits and dissonance in explaining the relationship between EHR system implementation and medical work practices. Specifically, the relationships between specific types of misfits (impositions versus deficiencies) and specific types of workarounds (changes in technology use versus changes in work routines) needs to be explored in more detail.

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